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Fan, Blower and Suction Pipe Systems

JOHN W. ROMIG[1]

THE handbook or text presenting theory and discussion on the subject of how to proportion blow or suction pipe systems generally gives the impression that there are many difficult and complicated formulæ and theories involved. The methods if carried out and every detail taken into consideration will result in a mass of arithmetic and algebra. For practical purposes many of the fine points may be omitted without noticeable sacrifice of any measurable advantages. It will be the purpose of this discussion to present in a simple manner sufficient information for laying out blow pipe or suction pipe systems that will function economically and satisfactorily.

Some of the basic considerations of blow pipe systems will be covered first. Blow pipe systems are used to conduct air or gases at a low pressure for processes, ventilation, heating and for combustion. The pipes or ducts are usually made of black or galvanized sheet iron. Black iron is slightly cheaper than galvanized iron but the price difference is so small that galvanized iron is preferable whenever low temperatures are involved; this is because black iron rusts readily, requires protective coating of paint and its length of service has limitations. High temperatures may cause the galvanizing to peel from galvanized iron pipes in which case black iron and heat resisting paint is preferable for permanent installations. The greatest cost of a blow pipe system lies in the labor cost of fabrication and erection so a small differential in metal cost has very little to do with the total cost of the ordinary blow pipe system. The labor cost varies from 4 to 8 times the metal cost depending upon method of fabrication and the nature of the job. With 4 cent per pound metal, blow pipe jobs can be done for 20 to 30 cents per pound fabricated and erected depending upon how complicated the design.

Round ducts should be used wherever possible. It takes less labor to fabricate round ducts and less metal is required to provide a certain area for flow. Rectangular ducts are difficult to form and elbows are often the source of excessive pressure loss. The most satisfactory rectangular duct is the square duct. On an equal area basis it takes 10 percent more metal to make a square duct of 1 sq. ft. area than a round duct 1 sq. ft. area and the weight is increased correspondingly. Another objectional feature of rectangular ducts lies in the fact that they are not as easy to erect as round ducts so labor costs run higher for square than for round ducts. A further disadvantage of rectangular ducts lies in the fact of the slow flow conditions in the corners of the cross section and the corresponding loss in pressure and restriction to flow unless an additional area allowance is made. The effective area of a rectangular duct is around 80% that of a round duct of the same diameter. If a rectangular pipe must be used the dimensions should be as near equal as is possible and allowance should be made for the inefficient flow in the corners.

In the design of piping effort must be made to get streamline flow conditions. Abrupt changes in direction of flow cause losses in pressure either in rounding a curve or in diverting a part of the bow in or out of a main line.

In a suction or pressure system the effect of 90° Branches from a main suction or pressure line is to create a turbulence and a crowding of the main line with the result that net useful area is reduced, pressure is lost and the capacity is reduced. The result of 90° Branches in pressure piping is to cause excessive pressure loss and turbulence at resulting in decreased flow in the branches so made. Loose dovetails extending into a main line interfere with flow. Branches at an angle of 30° to 45° from axis of pipe in the steamline direction are recommended.

It has been found from experiment that elbows should be made with a throat radius equal to or greater than one and one-half times the diameter of the pipe. There is no real advantage in increasing throat radius appreciably greater than 1½ times the pipe diameter. The one and one-half rule holds for large and small elbows, less than 90°, or more than 90° if conditions require such elbows. Stream line flow and ample area permit low pressure loss and satisfactory operation of a system at low power cost. Blast gates put in a piping system should be designed so that the frame does not restrict flow or set up turbulence. In case of high pressure blow pipe applications the location of gates should be made as near main lines as possible.

In the fan or blower connection for pressure work the outlet or hood should diverge slightly (10°), such divergence converts some static pressure into velocity pressure and aids in flow. Blowers as a rule have outlets designed for higher outlet velocity than is recommended for the ducts so this

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design feature is of double importance. Suction fans and exhausters are designed with inlets which boost the velocity higher than is usually desirable for the main ducts so a similar connection may be made to the inlet of a fan or exhauster.

For pressures or suctions exceeding 3" of water the joints should be soldered to keep losses of air or suction low. Riveted or spot welded joints or a combination of both are recommended for all blow and suction piping elbows and fittings. Ducts should be well supported at intervals not exceeding 10-15 feet. Screws form a cheap and satisfactory joint for field connections. Metal gauges suggested for suction and blow piping are shown in Table No. 1.

TABLE NO. 1

Dia. pipe Min. to max.		Gauge for pipe	Gauge for elbows, wyes and fittings
0	12	24	22
13	20	22	20
21	30	20	18
31	42	18	16

The gauges shown may be considered as rather heavy for low pressures. As a rule the pressure is not as important as the actual distortion of the duct while erecting and later when cleaning, sweeping, etc.; and heavy gauges are recommended for the sake of permanence. The gauges as shown correspond more nearly to those generally given for suction piping; however, rigidity and resistance to damage are considered very essential and heavier gauges are preferable as the cost is not in proportion to the weight. If the chance for damage is excessive even heavier metal should be used for a crushed duct hinders good operation and increases the power input for a given result.

Frquently it is of interest to determine just how a system is performing. The chief items of interest are first, the static suction or plus pressure, the velocity, the area of the duct, the volume handled and the horsepower or K.W. input for the result. A survey of an installation determining the static or suction pressure at intervals, particularly on each side of a critical section, junction elbow, reducer shows where excessive losses exist. If a system or a part of a system is operating unsatisfactorily a check on static or suction pressures will indicate the corrections that should be made.

Suction pressures must be adequate to give good removal of dust, fumes, or other material. In Table No. 2 sizes of branch pipes are shown together with volumes of air required to maintain given suctions. The data in Table No. 2 is furnished through the courtesy and permission of the Garden City Fan Company. Table No. 3 shows flow velocities and suction pressures required for some exhauster applications.

TABLE NO. 2

Size of pipes—Diameter in inches

Suction to be maintained—inches of water	3	4	5	6	7	8	9	10
1"	150	271	430	615	833	1090	1380	1707
1½"	187	334	525	751	1023	1335	1696	2093
2"	218	387	604	867	1180	1547	1952	2410
2½"	244	430	675	970	1322	1726	2184	2695
3"	267	475	740	1063	1448	1892	2388	2958
4"	306	546	855	1228	1671	2184	2762	3410
5"	343	609	955	1372	1869	2439	3090	3806
6"	373	663	1034	1482	2030	2650	3362	4150
7"	405	718	1115	1600	2195	2865	3634	4496

Velocities must be high for heavy materials to keep them from dropping and filling up the ducts. High velocities require a high power input for pressure losses are greater in the duct system. Care must be taken not to allow the large diameters or sections for these tend to fill with heavy material. The supporting system should be of ample strength

TABLE NO. 3

Suctions in inches of water for removal of material, etc.

Kind of material or work	Velocities in Ducts.	Static suction in inches of water
Grinding and buffing wheels	2500-3000	1-2
Exhaust from mixers, grinders, tumbling barrels	3000-4000	1-2
Exhaust from heavy duty wood working machinery	3000-4000	2-4
Exhaust from light duty wood working machinery	2500-3000	1-2
Exhaust from pottery processes	2500-3000	1-2
Exhaust from lead dust and heavy fumes	3000-6000	1-4
Exhaust from elevating and crushing machines	2500-3500	1-4
Exhaust light gases	1500-2500	½-1

to allow some filling in case a part of the system should be shut off for some reason or another and the remainder in operation. In operating a system it is inadvisable to cut a sufficient part of the system out of service to allow the velocity to drop excessively. Inspection doors should be provided at regular intervals for inspection of the duct and to remove accumulations that may gather. Regular inspections should be made of a suction system to determine just how the system is functioning and to guard against excessive stoppage or accumulation of material in the duct.

Losses in pressure in ducts are shown in Table No. 4 for various sizes of round pipes with varying velocities.

Table No. 4 is shown on the following page:

The information shown in Table No. 4 is applicable to pressure systems as well as suction systems. The volumes shown are in cubic feet of air per minute and the pressure losses are in inches of water per 100 feet of duct. The loss for 25 feet of duct would be twenty-five one hundredths that for a 100 foot run. The total losses for the various sections of a system must be added together to secure the total pressure that the fan or blower must overcome. A suction fan must overcome the total suction pressure and also must provide sufficient plus pressure to force the products exhausted to their destination and overcome the discharge resistance. The total work performed in a suction system by the fan is the sum of the two resistances, the inlet plus the discharge. Volumes are found by adding the volumes required for each branch. In this manner the complete specification of a fan for the installation are determined. A pressure blower seldom has a long suction pipe, if it should have, this fact must be taken into consideration in the formulation of its pressure specification. In addition there is the loss due to friction in the discharge line. The volume to be used is the total required at the various points of use.

It is of interest to check velocities and volumes of discharge from fans and blowers. The most practical method is by means of a Pitot tube (Pitot tubes are sold by most fan and blower manufacturers) and the use of the following formula:

$V = 4000\sqrt{h}$

$q = A\ V$

where V = the average velocity of air in feet per min. across duct.

h = average velocity head in inches of water and 4000 is a constant.

A = Area in sq. ft. of section where velocity pressure (h) is taken.

Q = Volume of air in cubic feet per minute.

There are corrections that may be applied for barometric pressures and for temperatures, however, for practical purposes there is little to be gained by making detailed corrections. If very accurate results are desired corrections are in order. If the gases to be handled are extremely hot, heavy or light in weight a temperature correction is in order as is also a correction for very high altitudes.

economies of each system. Horsepower loss due to friction is found by the formulæ No. A following:

$$\text{Formula A—HP} = \frac{\text{apm. x .000157 x F}}{\text{Total efficiency (as a decimal)}}$$

where HP = horsepower lost due to friction
apm = cu. ft. of air per minute

TABLE NO. 4

Dia. Pipe Inches	Velocity 2500 Volume	2500 Loss	3000 Volume	3000 Loss	3500 Volume	3500 Loss	4000 Volume	4000 Loss	5000 Volume	5000 Loss	6000 Volume	6000 Loss
4	220	2.9	260	4.20	310	5.60	360	7.5	.....	....	.....	....
5	340	2.3	405	3.30	480	4.60	544	6.0	680	9.3	.....	....
6	480	1.9	580	2.70	640	3.80	790	5.0	895	7.7	.....	....
7	625	1.7	795	2.40	865	3.30	1,070	4.3	1,310	5.6	1,600	9.5
8	870	1.5	1,080	2.00	1,250	2.70	1,420	3.8	1,750	5.35	2,150	8.2
9	1,125	1.3	1,300	1.80	1,600	2.50	1,747	3.3	2,250	5.1	2,700	7.4
10	1,350	1.25	1,650	1.65	1,920	2.30	2,200	3.0	2,750	4.7	3,280	6.6
12	2,000	.95	2,400	1.40	2,600	1.90	2,900	2.5	4,000	3.8	4,650	5.6
14	2,680	.85	3,200	1.20	3,600	1.60	4,100	2.3	5,500	3.3	6,250	4.8
16	3,500	.75	4,200	1.00	4,800	1.40	5,200	1.85	6,500	2.85	8,100	4.2
18	4,300	.66	5,200	.96	6,100	1.30	6,700	1.65	8,500	2.55	10,500	3.8
20	5,100	.60	6,500	.86	7,400	1.10	8,300	1.50	11,000	2.40	13,000	3.3
22	6,500	.54	7,800	.78	9,100	1.00	10,000	1.35	13,500	2.15	16,000	3.00
24	7,700	.50	9,400	.72	11,000	.98	12,000	1.25	15,800	1.90	18,900	2.90
26	9,100	.46	11,000	.66	12,500	.90	14,000	1.15	18,500	1.75	22,500	2.50
28	10,600	.43	12,800	.61	14,500	.84	16,500	1.05	21,500	1.65	25,600	2.30
30	12,200	.40	14,700	.57	17,000	.78	19,000	.96	25,000	1.54	30,000	2.20
32	13,500	.37	16,700	.54	19,000	.73	22,000	.90	28,500	1.40	34,500	2.10
34	15,000	.35	18,500	.50	21,500	.69	24,500	.87	31,500	1.35	38,000	2.00
36	17,000	.33	21,000	.475	24,000	.65	27,000	.80	35,700	1.25	42,500	1.90
38	19,000	.31	23,000	.45	26,500	.62	31,000	.76	40,800	1.20	47,000	1.80
40	21,000	.295	25,500	.43	30,000	.59	34,500	.73	45,000	1.15	53,500	1.70
42	23,500	.28	28,500	.41	33,000	.56	37,500	.70	47,000	1.10	57,500	1.65
44	26,000	.27	31,000	.39	36,500	.53	42,000	.67	53,500	1.05	64,000	1.57
46	28,000	.26	34,000	.37	39,500	.51	45,500	.64	57,600	1.00	69,000	1.50
48	31,000	.24	37,000	.36	43,500	.49	49,500	.61	65,000	.95	75,000	1.44
54	39,000	.22	47,000	.32	54,000	.44	63,000	.54	80,000	.85	90,000	1.28
60	48,500	.20	57,500	.29	67,000	.39	77,000	.48	100,000	.75	115,000	1.15

Loss in inches of water per 100 ft. of pipe.
Volume in cubic feet per minute. Table No. 4 (Courtesy Garden City Fan Co.)

Table No. 5 is very useful in the laying out of a blow pipe system. By proper use selections of diameters may be made for economy of power keeping the diameters within

F = Friction loss in inches of water.
The total efficiency is the efficiency of the motor, drive and fan or blower.

TABLE NO. 5

Velocity Dia. Pipe	500 P Loss	500 HP Loss	800 P Loss	800 HP Loss	1000 P Loss	1000 HP	1200 P	1200 HP	1500 P	1500 HP	1800 P	1800 HP	2000 P	2000 HP	2600 P	2600 HP	3000 P	3000 HP
4	.069	.0008	.178	.0034	.278	.0066	.400	.0114	.625	.0223	.900	.0385	1.111	.0529	1.877	.1162	2.500	.1785
5	.056	.0010	.142	.0042	.222	.0083	.320	.0143	.500	.0279	.720	.0482	.889	.0661	1.502	.1452	2.000	.2231
6	.046	.0012	.119	.0051	.185	.0099	.267	.0171	.417	.0335	.600	.0578	.741	.0793	1.252	.1743	1.667	.2677
7	.040	.0014	.102	.0059	.159	.0116	.229	.0200	.357	.0390	.514	.0674	.635	.0925	1.073	.2033	1.429	.3123
8	.035	.0017	.089	.0067	.139	.0132	.200	.0230	.312	.0446	.450	.0771	.556	.1058	.939	.2324	1.250	.3569
9	.031	.0019	.079	.0076	.123	.0148	.178	.0256	.278	.0502	.400	.0867	.493	.1190	.835	.2614	1.111	.4016
10	.028	.0021	.071	.0085	.111	.0165	.160	.0286	.250	.0558	.360	.0964	.444	.1322	.751	.2904	1.000	.4462
11	.025	.0023	.064	.0093	.101	.0182	.145	.0314	.227	.0613	.327	.1060	.404	.1454	.683	.3195	.909	.4908
12	.023	.0025	.059	.0102	.092	.0198	.133	.0343	.208	.0669	.300	.1156	.370	.1586	.626	.3485	.833	.5354
13	.021	.0027	.055	.0109	.085	.0215	.123	.0371	.192	.0725	.278	.1253	.341	.1719	.578	.3776	.769	.5800
14	.020	.0029	.051	.0118	.079	.0231	.114	.0400	.179	.0781	.257	.1351	.317	.1851	.537	.4066	.714	.6245
16	.017	.0033	.044	.0135	.069	.0264	.100	.0457	.156	.0892	.225	.1542	.278	.2115	.468	.4647	.625	.7140
18	.016	.0037	.040	.0152	.062	.0297	.089	.0512	.139	.1004	.200	.1735	.247	.2380	.417	.5228	.556	.8031
20	.014	.0041	.036	.0169	.056	.0330	.080	.0571	.125	.1115	.180	.1927	.222	.2644	.376	.5809	.500	.8923
22	.013	.0045	.032	.0186	.051	.0364	.073	.0628	.114	.1227	.164	.2120	.202	.2908	.341	.6390	.455	.9816
24	.012	.0050	.029	.0203	.046	.0397	.067	.0685	.104	.1339	.150	.2313	.185	.3173	.313	.6971	.417	1.0708
26	.011	.0054	.027	.0220	.043	.0430	.062	.0742	.096	.1450	.139	.2506	.171	.3437	.289	.7552	.385	1.1601
28	.010	.0058	.025	.0237	.040	.0463	.057	.0800	.089	.1562	.129	.2702	.159	.3702	.268	.8132	.357	1.2490
30	.009	.0062	.024	.0254	.037	.0496	.053	.0857	.083	.1673	.120	.2891	.148	.3966	.250	.8714	.333	1.3388
32	.009	.0066	.022	.0271	.035	.0569	.050	.0914	.078	.1785	.112	.3084	.139	.4230	.234	.9294	.312	1.4280
36	.008	.0074	.020	.0305	.031	.0595	.044	.1024	.069	.2008	.100	.3469	.123	.4759	.209	1.0456	.278	1.6062
40	.007	.0083	.018	.0339	.028	.0661	.040	.1142	.062	.2231	.090	.3855	.111	.5288	.188	1.1618	.250	1.7847
44	.006	.0091	.016	.0372	.025	.0727	.036	.1256	.057	.2454	.082	.4240	.101	.5817	.171	1.2779	.227	1.9632
48	.006	.0099	.015	.0406	.023	.0793	.033	.1371	.052	.2677	.075	.4626	.093	.6346	.156	1.3941	.208	2.1416
52	.005	.0107	.014	.0440	.021	.0859	.031	.1485	.048	.2900	.069	.5011	.085	.6874	.144	1.5103	.192	2.3201
56	.005	.0116	.013	.0474	.020	.0925	.029	.1599	.045	.3123	.064	.5406	.079	.7403	.134	1.6265	.179	2.4979
60	.005	.0124	.012	.0508	.019	.0991	.027	.1713	.042	.3346	.060	.5782	.074	.7932	.125	1.7427	.167	2.6771

P = Pressure loss by friction of air in pipes—oz. per 100 feet.
HP = Horsepower loss in friction of air in pipes—horsepower per 100 feet.
Note: 1 ounce equals 1.73 inches of water.

Courtesy B. F. Sturtevant.

reasonable limits. As a major portion of the cost suction or blowpipe system is labor and as labor does not vary directly with the diameter the extra cost of a system with small friction loss is not excessive. When considering a blow pipe system it is advisable to lay out more than one arrangement of diameters and to secure quotations (or make estimates) for each. Having costs it is easy to determine the

By the use of Formula No. A the horsepower loss for each system may be figured and the difference between the losses in two systems under consideration may be figured and the power cost of the operation over a period of a year may be readily computed at existing power rates. Initial economy in a system may in the end prove inadvisable and low first

(*Continued on page* 48)

Illustrating Progress Made in the Art of Sand-Blasting Glass

HUNTING, Fishing, gilded glasses, engraved with sand-blast, presented by the master-glassmaker J. J. K. Ray, in the dining room exhibited by M. Pierre Petit, architect, at the Salon of Artist-Decorators, 1931.

By the Artists, Architects and Artisans of France

IN these glasses, 10 to 13 mm in thickness, the deep engraving is shown to best advantage by oblique lighting.

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The Chickens Come Home to Roost

ONCE upon a time there was a great Sultan, whose dominion was from sea to sea, and his land produced all things abundantly, so that he waxed very wealthy. And he had a hundred million sons and daughters, and his name was Samuel. And he was devout and rendered frequent thanks to Allah that he was not as other men.

Now the Sultan had great store of gold and the desire came upon him to possess all the gold of the world. For the Ruler of the Isles of the Sea and other Potentates wished to trade with him, for the Sultan's land produced much desirable produce, and the Sultan agreed, but when they wanted to pay him back, he decreed that payment must be in gold. And his store of gold waxed exceedingly great, and he had to pull down his vaults and build larger, deep in the Archaean gneiss of his rock-ribbed fortress of Manhattan. And he gloated exceedingly; but the other potentates were compelled to discontinue trading with him, for that they had not enough gold wherewith to pay.

Then said the hundred million sons and daughters of the Sultan, "Is not the Old Man's gold, our gold? And did we not win it from the soil of our land, and by trade? And now, behold, he hath hidden it in his vaults, that he may gloat. And he hath given us paper money, promising to redeem it when we wish. And now, let us wish!"

So they hied them to the banks of Samuel, for the Sultan had certain favorite sons of whom he was very proud. They were the Bankers. And the other sons and daughters came and demanded gold, and it was found the Old Man had promised more gold than he possessed, and his favorite sons in turn had promised vastly more gold than they could lay their hands on. And when the other sons and daughters desired them to redeem their promises, they could not, and were sore at their brethren, and besought the Old Man to smite them.

Then was the Sultan wroth, and said, "Truly, my children are unruly children, and altogether evil and iniquitous. Do they not perceive the wickedness of trusting in gold, and in hoarding it? What says the Koran? 'The desire to multiply riches consumeth you; by no means should ye thus employ your time. Hereafter shall ye learn your folly'." And he chid them, forbidding them to hoard gold, and bidding them be more spiritually minded. And he told his favorite sons to ignore them, anad forbade them to use his gold, or their own. For he said, "The love of money is the root of all Evil. Shall they try to sell America for forty pieces of gold, even as I have sold the rest of the world?"

F. W. P.

Opal Glasses

RAPID strides have been made in the last year or two in understanding the true nature of opal glasses, and in determining the practical requirements of their manufacture. We have just received from England a copy of the *Illuminated Engineer* for February, 1933, in which there appear three papers on this subject:

The Theory and Specification of Opal Diffusing Glasses: Part I, by J. W. Ryde and B. S. Cooper.

Part II, by J. W. Ryde, B. S. Cooper and W. A. R. Stoyle.

Some Aspects of the Manufacture of Opal Glass, by W. M. Hampton.

The work of Ryde and Cooper in its more severely mathematical form is already familiar, but a simplified treatment found practicable in the last twelve months makes the subject intelligible to all. The practical requirements of manufacture are set forth by Hampton with his customary charm of style. Presumably the papers will appear again in the Journal of the Society of Glass Technology. They mark a distinct milestone in our understanding of the nature of glass.

Although opals of one kind and another have been known for a great many years, the subject has been a chaos until very recently. It is most probable that the placing of the thing upon a sound foundation will mark the beginning of a considerable extension of the field for opal glasses.

The Banks

THE hour of our emancipation is striking. After years of amateur banking, under a system suitable perhaps for the Middle Ages, the citizens of the United States are demonstrating their confidence in "the fundamental soundness of our banking system" by heroic measures. The governors and state legislatures are stepping in and conferring on them special immunities. It is a wise move, though in an effective democracy, the Federal government would have stepped in first.

We may perhaps now hope that the anarchy of American banking is drawing to an end. It clearly does not command entire public confidence as it stands, and although the public may be partly to blame for this, it is essential that even if the present system were theoretically perfect, it would be better to have a less perfect system provided the people trusted it. On this basis, the systems of Canada, England, Australia, or any other English-speaking nation are vastly better—at least in their own territories. There is good reason to think that Americans are not so much more intelligent than Canadians; and they might find a good deal of benefit in their colleague's banking ideas.

The fear of truly "National" banks, national in scope as well as in name, seems to be due to the fear of corrupt political control. The mistrust of the banks therefore arises ultimately in mistrust of politics, and the anarchy of our present banking system is an attempt to countervail the anarchy of the country's political life. Here again the country is in the Middle Ages, and might do well to consider whether its colleagues have nothing to show it.

America's Oldest Glass Factory

DR. SPARKS, of Alderson-Broddus College, Phillipi, W. Va., gave a most interesting lecture before the Glass Division at Pittsburgh, on the History of Jamestown Glass—America's Oldest Industry. The following is a brief abstract of his remarks on this subject:—

History reveals that the first boatload of early settlers in Virginia landed at Jamestown in 1607 and that they brought with them workmen and materials to establish a glass factory. From this point onward the records reveal only here and there a minor reference to events at the glass factory.

Recent discoveries coupled with a careful patching together of the written references have finally enabled a somewhat hazy though complete story of the glass history of Jamestown to be written.

The first location of the city of Jamestown has been partially washed away by the river and the remaining area is now covered by several feet of silt. Excavation has uncovered the remains of some of the early homes. They were substantially built and decorated with glazed tiles.

These beautiful houses were entirely destroyed during the Bacon rebellion. What happened to the glass plant is a matter of conjecture. It is known from the records that the glass factory was operating in 1610 and also that in 1612 business was good, but by 1617 the glass house was in a dilapidated condition. What brought this about is unknown, but it may well be that some epidemic caused the death of the glass workers.

The glass house of those days was a relatively simple affair. The furnace was constructed of blocks of sandstone nicely fitted on the inside but rough and plastered with clay on the outside. Wood was, of course, the fuel and the pots were of the open type. A supply of the pots were on hand having been brought from England. The buildings were made of slabs and the construction very rough. Weather permitting, the glass workers opened up the wall so that they were in effect almost outdoors.

If one starts excavating in the rear of the old hotel, it will be found that there is about two feet of river silt, then a layer of odd shaped oyster shells, six or eight inches of sand below this in which were discovered a large number of clay pipes. This sand and the pipes were the sweepings of the barroom floor which had been dumped over the back wall yard.

A few inches below the sand was discovered scraps from an earlier house—some English pottery and a crucible of the type used for melting gold. It should be remembered that Europe was filled with stories of the limitless supplies of gold from the New World and it was the lure of the yellow metal which brought many of the early settlers.

Farther down was discovered some German pottery evidently part of a beer mug, then some mortar and in this was found some glass and part of a bottle neck.

In 1621 there were four glass blowers and two assistants, Capt. Norton was in charge. Geo. Sanders who was secretary of the colony was second in charge. The old furnace was repaired and production again started in the old glass house. This time the adventure was purely a business proposition and the product was glass beads to be used as money for trade with the Indians. The production was carefully controlled to prevent an oversupply. Very few of these beads are still in existence, though some of them matching the glass found in pieces of the broken pots have been found.

The net result of this method of control was to keep the glass workers continually in a state of turmoil. Much of

the time they had nothing to do and were forced to amuse themselves making small pieces of art ware—some of which have been unearthed.

It has been reported that the glass plant was destroyed during the massacre of 1622. This is untrue, for it is recorded that some of the settlers were living in the old glass house in 1623-25. About this time, however, the glass house was completely destroyed. The official report says an infuriated Italian smashed the furnace with a crow-bar. The remains, however, show that this could not have been the case for the destruction is far too great. It seems probable that some sort of gas explosion blew the furnace to pieces and the Italian completed the wreckage by breaking up all the available pots with a bar. One of the pieces of a pot shows marks like those caused from the blows of the blunt end of a bar.

What happened to the workers is still a mystery. The census of 1624 shows two Italian glass workers living on the estate of George Sanders.

In 1624 the colony was dissolved and Sanders was free to make bottles. The colonists had planted vines and laid the groundwork for a wine industry. It was thought that a reasonably large bottle industry must have flourished soon after but the location of the glass house was a mystery until last year.

Meanwhile, the foundation of the large house belonging to George Berkley was discovered. The foundation was about 260 feet long and near one end contained a niche in which were found many bottles. All these bottles correspond in shape and in glass to the other bottles unearthed throughout the territory. It seems unlikely that all of these bottles could have been produced in one small furnace.

Last summer, in a gulley, a small moss covered mound was found. This mound proved to be the remains of a tank furnace about 18" x 40" inside dimensions. In the bottom of this was found an inch of melted glass and an old blow pipe. The glass had the same color of the bottles found in Berkley's house. This tank was made of blocks of clay and upon one of these is scratched the name and date HAL Aug. 1666. This was beyond doubt Berkley's furnace.

The location was ideal. Water was available from a nearby spring. Sand could be gleaned from the creek bottom and clay similar to that used for blocks was found in the creek bank opposite the furnace. Tests of the clay show that it was entirely suitable for the use to which it was put.

Since the wine business was distributed among several planters, it is thought that there were several of these small furnaces distributed throughout the territory. The records show another furnace existed in 1690 but it has not yet been discovered. One of the bottles found bears the initials "F.N." which are those of Sir Francis Nicholson, Governor of Virginia in 1690. Another bottle is dated 1632.

A furnace was started in 1677 in Alexandria, Va., employing five hundred people.

Glass to the extent of 10,000 pounds was exported in 1687.

Thus glass manufacture is America's oldest enterprise about which relatively little has been known until the last few years. It is hoped that the interest in this our oldest industry will attract sufficient funds to enable this search to be carried further.

Dr. Spark's lecture was one of the most enjoyable talks of the meeting. On exhibition was a variety of bottles, glass pots, beads and art-ware found during the excavating and searches on the site of old Jamestown. These were viewed by a large number of those attending the meeting and Dr. Spark's impromptu remarks regarding them were illuminating and interesting.

* * *

The Jamestown Glass Factory was the subject of a radio address recently by Professor A. Silverman of the University of Pittsburgh.

Fan, Blower and Suction Pipe Systems

(*Continued from page* 43)

cost may mean the most expensive system when cost of operation is included.

When it is necessary to contract for the installation of a system there should be a specification drawn up, as to performance, materials, quality of workmanship and stipulations as to proper design. Under performance of a system the following items are of real interest:

Volume-cubic feet of air per minute.
Static pressure at fan.
Horsepower into Fan.
Horsepower into prime mover.

Of interest under materials and workmanship and design.

Gauges and respective diameters.
Kind of metal.
Supporting structure.
Method of taking off branches, making of Ys, hoods, ells.
Design of system.
Diameters and areas of various sections.
Velocity and volumes in each section.
Static pressure at each end of each branch.
Friction loss in each of main sections.
Soldered, welded, riveted or other method of joining in detail.

A proper study of an existing blow or suction pipe system that do not function properly will lead to correction that makes for satisfaction. If a system is working very well it is often of interest to investigate it for it may be of considerable over capacity and may be causing a heavy power loss. Thought and study in planning and specifying a new system is well repaid, for a properly designed system will often save shutdowns of certain apparatus and will at the same time prove economical in power utilization. The foregoing data formula and suggestions give in a brief summary the chief items in the study and design of suction and blow pipe systems without delving into the many theories and complicated formula connected with air handling. General data and formula such as are given may be used safely for all practical purposes, if absolute accuracy is desired then it is necessary to look into the theories and formula with the corrections for each detail.

Tariff Commission Report on Blown Glass Tableware Costs

*Abstracts from Report No. 60, Second Series**

ON November 4, 1931, the United States Tariff Commission began hearings at Washington on the differences in costs of production of blown glass tableware in the United States and Czechoslovakia, the principal competing country manufacturing similar products. In its Report No. 60, second series, on this investigation of the Commission to the President on November 30, 1932, it was stated that the ratios of cost differences to the dutiable values vary widely for different groups of articles, being in some cases higher and in other cases lower than the existing duty, and that by reason of that fact the Commission had made no findings with respect to changes in the present rate of duty on kitchen articles and utensils wholly or in chief value of glass, blown or partly blown in the mold or otherwise, fixed by the Tariff of 1930, namely 60% ad valorem.

Summary of Information Obtained in the Investigation

Scope of the Investigation

An investigation of blown-glass tableware was instituted by the commission on July 22, 1930, in compliance with Senate Resolution 330, dated July 21, 1930. Public notice of the hearing was given on September 9, 1931. At this hearing, held in Washington, D. C., on November 4, 1931, parties interested were given reasonable opportunity to be present, to produce evidence, and to be heard, as required by law.

In the United States

Prior to the tariff act of 1930 the commission instituted an investigation of blown-glass tableware, in response to an application from an association of domestic manufacturers, and in 1928 obtained cost and related data for such ware for 1927 or 1928 at 11 domestic plants, operated by 10 companies. At the initiation of the 1928 investigation conferences were held with manufacturers in Pittsburgh and with importers in New York for the purpose of discussing a number of problems and the methods to be followed in obtaining data in this connection, and in selecting types of ware for which cost comparison was to be made. Extended preliminary field work was conducted during which there were selected for each domestic producer from 25 to 40 or more samples, and about the same number of samples for each importer, shown by searching analysis to be representative of the various transactions of the concerns involved. A study was also made of the costing methods employed in domestic plants and of available records for related data. Interviews were held with buyers in large department stores and retail glass stores, and their displays were carefully examined for the purposes of obtaining information regarding competitive conditions prevailing in the industry and trade.

In selecting the domestic plants, preference was given to those that appeared to have good or fair cost records, and consideration was also given to the size of the plants and their geographical location. Included in the plants selected were large, medium, and a few small producers. In selecting the articles used for purposes of cost comparison, consideration was given to kinds of ware produced by the various plants, whether lead, potash, or lime glass; quantity produced; and operating conditions affecting production. In order that the selected articles might represent a cross section of each plant's costs of production, articles produced in small, medium, and large quantity were selected. Articles with short, medium, and long stems and with stems drawn or pulled, or pressed, were included. The selection also included, a number of different designs of bowls and stems; ware with and without optic effects, all crystal, crystal and color combinations, all one color, color combinations, and etched. Cost data were obtained for goblets, saucer champagne, wine, cocktail, sherbet, and parfait glasses, regular tumblers (not footed), footed tumblers, and several other articles. After the sample selection was made at the 11 domestic plants, a conference was held in New York City with representative importers, at which time they were informed of the classes and kinds of articles that had been selected, and at their request several additional articles were later added. At each domestic plant approximately 30 or 40 articles were finally selected as representative of the plant's production which in many cases consisted of several thousand different articles. The selected articles are representative of the bulk of the blown-glass tableware produced in the United States. Field work in connection with the 1928 investigation was suspended during consideration by Congress of the revision of the tariff act of 1922. Under the provisions of the tariff act of 1930 the investigation was dismissed without prejudce.

During November, 1930, field work in connection with the investigation instituted on July 22, 1930, was undertaken to determine whether the articles selected for costing in 1928 were representative of domestic and imported blown-glass tableware as of 1929-30. It was disclosed that many of the articles for which cost data were obtained in 1928 were still representative, but a selection was also made of some articles of different types, colors, or decorations which had been placed on the market subsequent to that year. Samples of domestic and imported ware considered to be representative of recent competitive conditions were assembled in New York City for inspection by representatives of domestic and foreign producers. A tentative selection of 286 comparable articles was made after all articles had been examined by representatives of domestic producers and importers. At the public hearing held in Washington in November, 1931, representatives of domestic and foreign producers gave general approval to the tentative selection. The articles finally selected were representative of both domestic and imported articles of blown-glass tableware as of 1929 and 1930. Data later obtained at domestic plants made it possible to convert the 1927-28 costs to costs for 1929-30, and detailed data were also obtained for the additional samples selected.

*Copies of this 60-page report containing numerous tables relating to the production, consumption, costs of blownware and other data may be obtained at 10 cents a copy from the Superintendent of Documents, Washington, D. C.

In Czechoslovakia

In the summer of 1931 the commission obtained cost and related data at five plants in Czechoslovakia for articles of hand-blown glass tableware like or similar to articles for which cost were obtained in the United States. The selected articles for which cost data were obtained are representative of the bulk of the blown-glass tableware imported into the United States from Czechoslovakia during the cost period. A further check of the adequacy of the selection was made by preparing a loose-leaf book containing illustrations of the key articles selected in the domestic industry for examination by each of the Czechoslovakian manufacturers from whom cost data were obtained, in order that they might become acquainted with the samples of domestic ware that were regarded as comparable with their ware, and in addition this was designed to facilitate the selection of articles produced in Czechoslovakia but not exported to the United States.

Description and Uses

Table and kitchen articles and utensils, wholly or in chief value of glass, blown or partly blown in the mold or otherwise, hereinafter referred to as blown-glass tableware, include such articles as goblets, champagne, sherbet, and wine glasses, tumblers, finger bowls, cruets, and water bottles. There are many varied articles of blown-glass tableware manufactured. In stem ware, such as goblets and wine glasses, the bowls may be of many varied shapes, and may be plain or with one of a number of optic effects. Optic effects include narrow, wide, diamond, and spiral types. The stems may be short, medium, or long; they may be drawn, offhand stuck, or pressed; they may be undecorated or very ornately decorated; they may be formed from one or from several solid pieces of glass; or they may be hollow. Blown-glass tableware is produced in crystal (uncolored), and in colors such as green, rose, blue, orchid, amber, golden, ruby, black, and others. In stem ware the bowls are sometimes produced in crystal, with the stem and foot colored, or the bowl may be of one or more colors and the stem and foot of other colors, or crystal. Blown-glass tableware is decorated largely by needle, plate, and pantograph etching, by gold or silver deposits, or by incrustations, by painting or enameling, or by cutting and engraving. The bowls of stem ware may be composed of two or more layers of glass, usually different in color, thus forming what is known as plated or cased glass; cutting through the outer surface exposes as desired one or more of the colors, thereby making possible considerable variation in effect and design. Articles of stem ware vary considerably in size and in liquid capacity; goblets, for example, are produced with a capacity ranging from about 7 to 11 or more ounces.

Rates of Duty

Blown-glass table and kitchen articles are specifically provided for under the tariff act of 1930, paragraph 218 (f), which reads as follows:

> Table and kitchen articles and utensils, and all articles of every description not specially provided for, composed wholly or in chief value of glass, blown or partly blown in the mold or otherwise, or colored, cut, engraved, etched, frosted, gilded, ground (except such grinding as is necessary for fitting stoppers or for purposes other than ornamentation), painted, printed in any manner, sandblasted, silvered, stained, or decorated or ornamented in any manner, whether filled or unfilled, or whether their contents be dutiable or free, 60 per centum ad valorem.

Such articles were specially provided for under a similar provision in the tariff act of 1922, paragraph 218, at the rate of 55 per cent ad valorem.

Processes of Manufacture

Hand-Blown Glass Tableware

The raw materials used to produce glass are melted in crucibles (known as "pots") constructed of refractory fire-clay materials, or are melted in tank furnaces that are also constructed of refractory materials. As many as 16 pots may be placed in a pot furnace, thus permitting the simultaneous melting of a number of glass batches of different colors, whereas glass of one color only may be melted in a tank furnace at one time. Hand-blown glass tableware may be either blown offhand (without the use of molds) or blown in a mold. In the manufacture of stem ware there are four general processes, each of which has variations, namely, pressed stem and foot, drawn or pulled stem, offhand stuck stem, and blown offhand. The pressed stem and drawn or pulled stem processes are the two most generally used in the United States, although there is some domestic production by the offhand stuck stem and blown offhand processes. The blown offhand and offhand stuck stem processes are used for practically all of the hand-blown glass stem ware produced in European plants.

The first step in the manufacture of a goblet with a pressed stem is for the gatherer to dip a blowpipe into the pot or tank furnace and secure on the end of the pipe a gather or lump of glass sufficient to make the bowl of the goblet. After necessary amount of manipulation this gather is inserted in a mold and blown to the desired shape, and then the bowl is placed in another mold and molten glass is forced against the bowl either from the top or bottom of the mold in order to form the pressed stem and foot. In the drawn or pulled stem process, a sufficient amount of glass is gathered to form both the bowl and stem, and before the gather is placed in the blow mold the stem is pulled down from the bottom of the bowl, and after the bowl is blown another gather of glass is made for the foot, which is cast on. In the offhand stuck stem process, after the bowl is blown, gathers are made for forming a stem and cast foot. In the blown offhand process great skill is required, as no mold is used, the blower shapes the gather to form the bowl, after which a stem and foot are formed, and the article is then completed by the use of shears and various other finishing tools.

As soon as articles of hand-blown glass tableware are completed at the furnace they are placed in an annealing lehr in order to remove as far as possible the internal stresses in the glass. After the ware is removed from the lehr, all articles except those produced by the blown offhand process must go through finishing operations in order to remove surplus glass formed during the blowing operation. These finishing operations consist of cracking off the surplus glass, grinding the rim to remove all rough places, and then glazing by melting the sharp rim to a rounded surface. After these finishing operations all ware is wiped, finally inspected, and then packed or sent to the decorating department.

Glass Tableware Blown or Partly Blown by Machine

The production of glass tableware, blown or partly blown by machine, is largely confined to tumblers; in addition, goblets and sherbets are also produced by press-blow machines. The glass used for tableware produced by automatic or semiautomatic machines is generally melted in continuous tank furnaces. In connection with the production of tumblers (not footed) by automatic press-blow machines, automatic feeder devices release the necessary amount of molten glass and drop it into the proper mold in the rotating machine. A plunger that presses the glass to the sides and bottom of the mold also makes the desired cavity as well as an overflow of glass necessary for the next operation, where the glass is blown to the shape of the mold and then transferred to the annealing lehr. Goblets and sherbets are also produced by automatic press-blow machines similar to the one just mentioned. Tumblers are also produced on semiautomatic blow machines; in this process the gather is made by workmen. The articles produced by machines must go through the finishing operations of cracking off, grinding, and glazing. Tumblers are also produced by a full automatic blowing machine that performs the operations of the skilled workers in the hand process. The ware produced by this type of machine goes through a combination finishing operation that burns off the surplus glass and at the same time leaves a rounded rim.

Methods of Decorating

The decorating of glass tableware is in general confined to articles of hand-blown glass tableware, although machine-processed ware is in some instances decorated by cutting or by needle etching.

All decorating by etching embodies the same principle, whether it is plate, needle, or pantograph. In these three processes, the articles are covered with wax, except that part of the glass on which the desired pattern is to be etched. The articles are dipped in an acid solution which eats away the exposed surface of the glass. The finest and most intricate etched designs are produced by the plate etching process. Needle etched designs are confined to geometric patterns, such as the familiar "barrel scroll" or the "Grecian key." Pantograph etching makes possible more intricate designs than needle etching, and although quite similar to plate etching, usually the pattern embodies less detail, and the resulting decoration does not have as great a degree of precision as the plate-etched pattern. Glass tableware may be cut by the use of natural or artificial stones, or engraved by the use of copper disks. Other forms of glass decoration include iridescent, luster, and other effects, and gold or silver bands and incrustations.

The Blown-Glass Tableware Industry

In the United States

The manufacture of hand-blown glass tableware is a long-established industry in the United States, some ware having been produced as far back as the seventeenth century. In the early days, plants producing blown-glass tableware were located in the center of forests, thus insuring a good supply of wood for fuel and potash from the wood ashes, or they were located near a source of good glass sand (silica), or in some cases the determining factor was nearness to important markets. About the latter part of the eighteenth century, the importance of coal as a fuel was recognized in that a good supply would permit permanent plant location in contrast to the necessity of moving after a long haul became necessary because of the depletion of the nearby supply of wood for fuel. At the present time the location of domestic plants producing blown-glass tableware, in general, may be attributed primarily to nearness to coal, natural gas, or silica.

In 1930 it is estimated that there were about 28 domestic plants producing hand-blown glass tableware. In that year three of the companies producing such ware were also producing machine-blown or press-blown glass tableware, and in addition four other companies were producing tableware, blown or partly blown by machine. In 1930 there were in addition to the manufacturers engaged in the production of hand and machine-blown glass tableware at least 33 establishments that purchased such ware from the manufacturers and decorated it by cutting, engraving, or some other type of decoration.

Costs on blown glass tableware were obtained from 11 hand-blown glass tableware manufacturers, located in Ohio, W. Va., N. Y., 2 machine blown or partly blown table glassware manufacturers located in Ohio, 2 cutting, engraving and decorating establishments in Ohio and 1 in N. Y., a total of 16 plants.

Two plants from which cost data were obtained for machine-blown or partly blown ware also produce, and cost data were obtained from them for hand-blown ware. Of the remaining 5 plants producing machine-blown or press-blown ware, 1 plant also produced hand-blown ware and 1 used a semiautomatic process. This map also shows the location of the 11 plants from which cost data were obtained for hand-blown glass tableware, as well as 17 other hand-blown glass tableware plants from which cost data were not obtained.

Data obtained by the commission indicate that in 1930 West Virginia ranked first in value of production of hand-blown glass tableware, Ohio second, and Pennsylvania third. In 1930 Ohio ranked first in value of production of machine-blown or press-blown glass tableware.

The official statistics of the Bureau of the Census do not segregate the domestic production of blown-glass tableware. In 1925 the value of production of blown-glass tableware, as estimated by the American Association of Flint and Lime Glass Manufacturers, was $10,500,000. Data obtained during field work at domestic plants and from replies to letters sent to the industry by the commission indicate total sales or value of production for hand-blown glass tableware by 24 plants in 1928 of about $8,350,000; in 1929, about $9,008,000; and in 1930, about $7,760,000. In 1930 reports from these 24 plants and from 2 additional plants indicate a total production of $8,227,000. There is a constant fluctuation in the number of plants engaged in the production of hand-blown glass tableware. It is estimated that about 28 plants were operating during 1930. In 1929 seven plants reported to the commission production of table glassware, blown or partly blown by machine, having a total value of

approximately $6,855,000; in 1930 the total value of such ware produced by these seven plants was approximately $6,686,000 (tumblers represent a very large part of this total production.) According to these figures the 1929 domestic production of hand and machine-blown glass tableware was about $15,863,000 and in 1930 about $14,913,000. In 1930, in addition to the manufacturers engaged in the production of hand and machine-blown glass tableware, there were at least 33 domestic plants that purchased such ware from the manufacturers and decorated it by cutting, engraving, or enameling, etc. The finished product of these plants is sold through practically the same trade channels as the ware produced by the glass manufacturers, namely, department stores, retail glass and china stores, etc. A number of these cutting and decorating plants buy imported "blanks" (the trade name for undecorated glassware that is sold for decorating purposes). Data supplied the commission indicate that the total value of production in 1928 for 31 decorating plants was $2,246,000; in 1929, $2,182,000; and in 1930, $1,866,000. Attention is called to the fact that these figures include the cost of the hand- and machine-blown "blanks" purchased from the domestic and foreign glass manufacturers.

In general, the domestic manufacturers of hand-blown glass tableware may be divided into two groups: (1) Those producing ware from lime glass melted in tank furnaces, and (2) those producing ware from glass melted in pot furnaces. In the first group there are about eight plants whose production accounts for approximately 25 per cent of the total value of the domestic production of hand-blown glass tableware. The lime tank ware is sold at considerably lower prices than the hand-blown stem ware produced from pot-furnace glass. These lime-tank articles closely correspond in general appearance to the more expensive ware produced from pot-furnaces.

The manufacturers of hand-blown glass tableware who melt their glass in pot-furnaces may be subdivided into two groups. In the first group there are about 17 plants producing in some cases stem ware ranging from very near the price of some of the ware made from continuous tanks to the best of the general commercial hand-blown glass tableware. This group of plants may be further subdivided by reason of specialization in the production of hotel and restaurant glassware, etc. These plants together produce practically every type of stem ware, in many varied colors, in drawn and pressed stems, and many decorations, such as needle, plate, and pantograph etchings, as well as cut and engraved glassware, enamel applications, etc. The imports of blown-glass tableware compete largely with the products of these 17 manufacturers. A large part of the stem ware produced by this group is made with pressed stems, and plate etchings are very generally used as a means of decoration.

In addition to the group of manufacturers producing the general lines of stem ware there are a few domestic manufacturers producing the highest grades of stem ware also made from glass melted in pot-furnaces. The product of one of these manufacturers is confined almost entirely to cut and engraved crystal stem ware. Another produces stem ware that is, on the whole, comparable with the finest articles of stem ware produced in the world. A third plant also produces comparatively expensive lines of art stem ware as well as other ornamental and artistic articles of glass tableware. The products of these three plants compete with the highest grades of imported glassware, such as the English and Swedish cut crystal, Venetian glassware, and the most expensive ware from some of the other European countries. In addition, several of the manufacturers producing less expensive ware also produce high-grade cut crystal and art glass tableware.

In Europe

Although the European blown-glass tableware industry is an important one, specific statistics of production are not available for any European countries. It is known, however, that Czechoslovakia, Germany, Belgium, France and England have large hand-blown glass tableware industries. Other important producing countries are Sweden, Italy, and Holland; hand-blown glass tableware is also produced in Norway, Denmark, Poland, Austria, and Hungary. Available information indicates that glass tableware, blown or partly blown by machine, is produced in Germany and Belgium and probably in some other European countries.

Czechoslovakia.—In Czechoslovakia, the principal source of imports into the United States, the manufacture of hand-blown glass tableware is one of the important branches of the glass industry, which is one of the largest and oldest industries in that country. The first glass works in Bohemia was founded early in the eleventh century. The five companies from which cost data were obtained were founded, and in most cases the plants started operating, in 1813, 1836, 1842, 1860, and 1873, respectively. These five plants are located in what once were or still are forest districts, and most of these plants still use wood as their sole, or one of their principal, fuels. Coal, glass, sand, and other raw materials must be transported considerable distances from their sources.

It is estimated that Czechoslovakia usually absorbs only 20 per cent of its glass production, and that 80 per cent is exported. In 1930 it was stated by a Czechoslovakian authority that there were only nine companies producing hand-blown glass tableware in Czechoslovakia.

As previously mentioned, data are not available regarding the total production of Czechoslovakian hand-blown glass tableware. It is estimated by the authority before quoted that the production during the period 1929-30, of the five companies from which cost data were obtained, represented 85 per cent in value of the total Czechoslovakian production of hand-blown glass tableware in that period. On the basis of this estimate the Czechoslovakian sales of hand-blown glass tableware in each of the years 1929 and 1930 amounted to approximately $1,500,000. In addition to the companies producing hand-blown glass tableware and which also etch, cut, or otherwise decorate their own glass, there are a number of establishments in Czechoslovakia that purchase "blank" (undecorated) articles and decorate them for sale in competition with the glassware manufacturers. These decorating companies differ from the decorating establishments

in the United States in that many of the Czechoslovakian companies buy the blank articles, and the actual decorating of the articles is performed by workers in their own homes. When the decorated articles are returned to these "refineries" or decorating establishments, they are assembled and packed for shipment. A few of the larger "refineries" operate their own establishments, as is the practice in the decorating establishments in the United States. Haida, in northern Bohemia, is the outstanding center of the glass decorating industry. It was estimated that in 1929 there were 5,000 home workers decorating glass in the neighborhood of Haida. The quantity and value of the hand-blown glass tableware decorated in establishments other than the glass-producing plants are not known.

The Mississippi Glass Company recently announced that it has offered to donate any rough rolled or wire glass that may be required in the construction of the swimming pool at the White House for President Roosevelt, for which funds are being collected by admirersss ossfs stshse President.

Inquiries Received

581. We are manufacturers' agents operating on a commercial basis and being desirous of securing a line of fruit jars similar to Mason jars the writer has recently come to New York from Manila to make such contacts. It would be greatly appreciated if you would send us a list of reliable manufacturers in the above line. For further information address THE GLASS INDUSTRY, 2 Duane Street, New York.

February Plate Glass Production

The total production of polished plate glass as compiled by P. A. Hughes for the member companies of the Plate Glass Manufacturers Association of America for the month of February, 1933, was 4,955,293 sq. ft., as compared to 6,188,263 sq. ft. produced by the same companies in the preceding month, January, 1933, and 6,426,905 sq. ft. produced by the Association members in the corresponding month last year, February, 1932.

James W. Collier of Vicksburg, Miss., who was nominated by the President on March 23 to fill a vacancy of the Tariff Commission and whose appointment was confirmed by the Senate on March 27, qualified on March 28 as a member of the Commission. Mr. Collier was in the House of Representatives from November, 1928, to March 4, 1933, during the last part of the term as Chairman of the Committee of Ways and Means.

The annual meeting of the American Ceramic Society will be held during the week of February 11, 1934, Cincinnati, Ohio.

J. W. Cruikshank of Tahiti, the well known glass plant engineer, is still in this country and gave a lecture to the Adventurers Club at Los Angeles on February 23, exhibiting moving pictures of the local ladies of Tahiti and other forms of local color. It appears that he also gave some Tahitan songs which are something new to Dr. F. W. Preston, who sends this item, and who states that if Mr. Cruikshank comes to Pittsburgh the glass men of that district shall have to get him to sing for them.

GLASS CONSULTANTS

THE SHARP-SCHURTZ COMPANY
CHEMISTS AND CONSULTING ENGINEERS
FOR THE GLASS INDUSTRY
LANCASTER, OHIO U. S. A.

BAILEY & SHARP CO.
INCORPORATED
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F. W. PRESTON
CIVIL ENGINEER AND GLASS TECHNOLOGIST
BUTLER, PA.

DESIGNERS and CONSTRUCTORS OF THE BETTER GLASS PRODUCING UNITS
Toledo Engineering Co., Inc.
983 FRONT ST. TOLEDO, OHIO

Current Prices of Glass-Making Materials

March 21, 1933

Quotations furnished by various producers, manufacturers and dealers.

Acid		Carlots	Less Carlots
Citric (dom.)	lb	..	.29
Hydrochloric (HCl) 20° tanks, per 100 lb		..	1.10
Hydrofluoric (HF) 60% (lead carboy)	lb	..	.13½
52% and 48%	lb	.10	10-.11¼
Nitric (HNO_3) 38° carboy ext. Per 100 lb.		5.50	..
Sulphuric (H_2SO_4) 66° tank cars	ton	15.50	..
Tartaric	lb	..	.20
Alcohol, denatured	gal	..	..
Aluminum hydrate ($Al(OH)_3$)	lb	.04-.04½	.05½-.06
Aluminum oxide (Al_2O_3)	lb	.07	.09
Ammonium bifluoride (NH_4) FHF	lb	..	15½
Ammonia water (NH_4OH) 26° drums	lb		
Antimony, metallic (Sb)	lb	02½	02¾
Antimony oxide (Sb_2O_3)	lb	.06⅜	.06⅞
Antimony sulphide (Sb_2S_3)	lb	..	.08½
Arsenic trioxide (As_2O_3) (dense white)		..	.14
99%	lb	.04	04½
Barium carbonate ($BaCO_3$), Crude, (Witherite) 90%, 99% through 200 mesh	ton	56.50	..
90% through 100 mesh	ton	44.00	..
Barium hydrate ($Ba(OH)_2$)	lb	..	.05
Barium mixture, glassmaker's, f.o.b. St. Louis	ton	25.00	..
Barium nitrate ($Ba(NO_3)_2$)	lb	..	.07¼
Barium selenite ($BaSeO_3$)	lb	..	..
Barium sulphate, in bags	ton	19.00	24.00
Barium sulphate, glassmaker's, carlots bulk, f.o.b. shipping point	ton	15.00-16.00	18.00
Bone ash	carlots, lb	.06	.06
Borax ($Na_2B_4O_7 10H_2O$)	lb	..	..
Granulated	In bags, lb.	.02	.02¼-.02½
Powdered	In bags, lb.	.02¼	.02½-.02¾
Boric acid (H_3BO_3)	In bags, lb.	.04¼	.04½-.04¾
Cadmium sulphide (CdS)—			
Red	lb	..	.60-.75
Orange	lb	..	.55-.65
Yellow	lb	..	1.30-1.50
Chromium oxide (Cr_2O_3)	lb	.18½	.19
Cobalt oxide (Co_2O_3)			
In bbls.	lb	..	1.15
In 10 lb. tins	lb	..	1.25
Copper oxide			
Red (Cu_2O)	lb	..	.25
Black (CuO)	lb	..	.17-.19
Black prepared	lb	..	22
Cryolite ($Na_3Al F_6$) Natural Greenland Kryolith)	lb	.08½	.09
Synthetic (Artificial)	lb	..	.08
Epsom salts ($MgSO_4$) (imported) technical	Per 100 lb.	..	1.50-1.75
Feldspar—			
100 mesh	ton	11.50-17.50	12.00-18.00
80 mesh	ton	11.00-11.50	13.00
40 mesh	ton	10.75-11.00	12.00
20 mesh	ton	9.50-11.00	..
Granular	ton	9.50-11.00	..
Semi-granular	ton	9.50-11.00	..
Fluorspar (CaF_2) domestic, ground, 96-98% (max SiO_2, 2½%)			
Bulk, carloads, f.o.b. mines	ton	30.00	..
In bags or barrels	ton	31.00	39.00
Imported	ton	30.00-38.00	.30
Formaldehyde	lb	..	.07
Graphite (C)	lb	..	04-.07
Iron oxide—			
Red (Fe_2O_3)	lb	..	.0425
Black (FeO)	lb	.04½	..
Kaolin (f.o.b. mine)	ton	8.00-9.00	..
English, lump, f.o.b. New York	ton	14.50-25.00	24.50-30.00

Kryolith (see Cryolite)		Carlots	Less Carlots
Lead chromate ($PbCrO_4$)	lb	..	.30
Lead oxide (Pb_3O_4) (red lead)	lb	.055	.06½
Litharge (PbO)	lb	.045	.05½
Lime—			
Hydrated ($Ca(OH)_2$) (in paper sacks)	ton	5.50	..
Burnt (CaO) ground, in bulk	ton	4.00	..
Burnt, ground, in paper sacks	ton	6.00	..
Burnt, ground, in 280 lb. bbls.	Per bbl	2.15	..
Limestone ($CaCO_3$)		1.50-2.50	..
Magnesia (MgO)—			
Calcined, heavy (in bbls.)	lb	06	07
light (in bbls.)	lb	..	22
extra light (in bbls.)	lb	..	27
Magnesium carbonate ($MgCO_3$)	lb	06	10
Manganese 85% (MnO_2)	lb	03	03
Nickel oxide (Ni_2O_3), black—			
for nickel content	lb	..	35
Nickel monoxide (NiO), green—			
for nickel content	lb	..	.35
Plaster of Paris, bags	ton	21.00	23.00-29.00
Potassium bichromate ($K_2Cr_2O_7$)—			
Crystals	lb	.07½	.08
Ground	lb	.08	.08½
Potassium carbonate—94-96%	lb	055	055
Calcined (K_2CO_3) 96-98%	lb	.05⅞	..
Hydrated 80-85%	lb	.05¼	.05¾
Potassium chromate (K_2CrO_4)	lb	..	.25
Potassium hydrate (KOH) (caustic potash)	lb	07½	08
Potassium nitrate (KNO_3) (gran.)	lb	..	06-06¼
Potassium permanganate ($KMnO_4$)	lb	.16½	.17
Powdered blue	lb	..	.24
Rochelle salts, bbls.	lb	..	.11½
Rouge	lb	..	..
Rutile (TiO_2) powdered, 95%	lb	.15-.20	20-.25
Salt cake, glassmakers (Na_2SO_4)	ton	18.00	..
Selenium (Se)	lb	..	1.70
Silver nitrate ($AgNO_3$)	(100 oz.) per oz	..	.20¼
Soda ash (Na_2CO_3) dense, 58%—			
Bulk, on contract	Flat per 100 lb	1.05	..
In barrels	Per 100 lb	1.38	1.90-2.13
In bags	Per 100 lb	1.17½	1.72½-1.92½
Spot orders .. 025 per 100 lbs. higher		..	..
Sodium bichromate ($Na_2Cr_2O_7$)	lb	.04½	.05
Sodium hydrate (NaOH) (caustic soda) Solid	Per 100 lb	2.50	..
Sodium nitrate ($NaNO_3$)—			
Refined (gran.) in bbls.	lb	..	3.62
95 per cent	Per 100 lb	1.195-1.295	1.145-1.345
Sodium selenite (Na_2SeO_3)	lb		2.00
Sodium fluosilicate (Na_2SiF_6)	lb	.04½	.05-.06
Sodium uranate (Na_2UO_4) Yellow or Orange	lb	..	1.40-1.45
Sulphur (S)—			
Flowers, in bbls.	Per 100 lb	8.45	8.80-4.00
Flowers, in bags	Per 100 lb	8.10	8.45-3.65
Flour, heavy in bbls.	Per 100 lb	8.85	8.20-3.40
Tin chloride ($SnCl_2$) (crystals)	lb	37½	39
Tin oxide (SnO_2) in bbls.	lb	28	29½
Uranium oxide (UO_3) (black, 96% U_3O_4)			
100 lb. lots, Black	lb	..	2.75
Yellow	lb	..	1.50
Zinc oxide (ZnO)	lb	08½	12
American process, Bags	lb	05¾	.06
Zircon			
Granular (Milled .005-.02c higher)		07	07½-.08
Crude, Gran. (Milled .005-.02c higher)		03¼	04-.05